DEVELOPMENT OF SENSOR-BASED PROTOTYPE ROBOT FOR AUTOMATED FOOD DELIVERY

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Abstract

The food delivery process in Indonesia generally still uses a manual system and queues often occur in stalls at lunch time, especially when an employee is absent or sick. This makes customers have to wait a long time to be able to get food. From the problems above, the researchers took the initiative to create a prototype robot that can deliver food automatically, thereby easing the work of waiters in delivering food. The type of research used is qualitative research using the prototype method. The results show that the robot will move to the destination table by selecting the available menu on the Keypad Shield LCD display. After one of the menus is selected then press the right button on the LCD menu until the Red Table On display appears if red is selected. Then the robot will move towards the destination table according to the input given. If the order is ready to be delivered, the robot will automatically return to its original place. Based on the results of the research above, it was concluded that the prototype could run well and make it easier for business people or restaurants to deliver orders to the consumer's table.

Keywords: *LCD Keypad Shield, Prototype, Restaurant, food delivery, Robot..*

1. Introduction

The development of technology in the present era has been rapidly advancing, making all lines of human work easier, thus transitioning human life from manual systems to automated systems. The implementation of the 5.0 industrial revolution within the country is still uneven across all regions. Some companies have already implemented robotics technology, but it is still minimal in the culinary industry. The role of a waiter/waitress in a cafe or restaurant is crucial because they directly interact with customers, making it a primary function in advancing a business establishment [1], [2].

Robotics is one of the rapidly developing branches of technology. This development encompasses the fields of mechanics, electronics, and computer science, often referred to as mechatronics. Robotics technology has been widely applied in factory machines, which are useful for producing products in large quantities. Robots have many advantages, including being practical, fast, precise, and capable of working full-time. One commonly used robot is the avoider robot. The avoider robot is a wheeled robot that functions to detect obstacles or barriers in front of it and tries to avoid them [3], [4]. This robot is also equipped with a TCS230 color sensor, which is used to detect colors on each dining table.

In Indonesia, the common practice for delivering food to customers is through waiters/waitresses. Waiters play an important role in establishments such as restaurants, cafes, and others. If a waiter is absent or sick, the company will experience a shortage of staff, which can lead to customer discomfort due to longer waiting times for their orders. To anticipate such situations, the author intends to create a robot that can work in delivering food to customers, making the process more convenient and faster. The use of robots as waiters can also help businesses save expenses since robots do not require food, drinks, and other necessities. A robot only needs sufficient current and voltage to function normally.

This sensor-based food delivery robot operates by pressing the right button on the LCD Keypad Shield display, which will show the "Red Table On" message if the red color is selected. Then, the robot will move towards the designated table. Once the robot reaches the intended table, it will pause briefly to process the order. After a few seconds of delay, the robot will move back to its original position. The LCD display has several menu items that can be selected based on the desired table direction. There are four menu items: Red, Green, Blue, and Clear.

This robot utilizes three ultrasonic sensors positioned in the middle, right side, and left side of the robot. These sensors function to detect obstacles or barriers in front of it. Additionally, the robot is equipped with one TCS230 color sensor, which is used to detect the color beneath the dining table. This sensor is employed as a table identifier. Once the sensor detects the color on the table, the robot will stop and move according to the predetermined instructions. The TCS230 sensor can detect the primary colors of Red, Green, and Blue (RGB).

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2. Method

The research employed a qualitative approach using the prototype method. The prototype method is an interactive system process where requirements are continuously modified in a working system and improved through user collaboration and analysis.

Based on the above excerpt, users will provide feedback to the researcher regarding the shortcomings and errors of the developed device, allowing the researcher to reanalyze and rectify the mistakes. The nature of the prototype method itself is characterized by constant changes to the device.

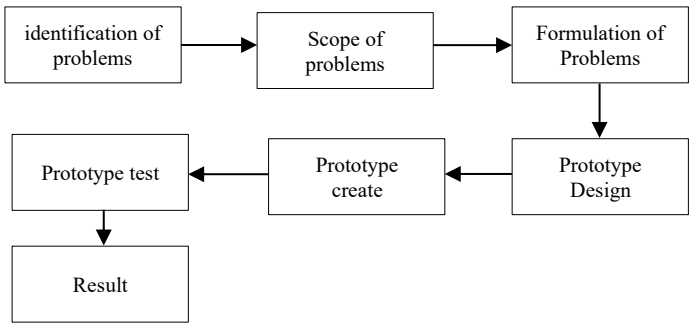


Figure 1. Research Framework

3. Flowchart and Design

A flowchart is a graphical representation of the steps and sequence of procedures in a program. The design of a robot should have a clear workflow, ensuring that it is well-

organized and easily understandable for readers [7]. For a clearer understanding, please refer to Figure 2.

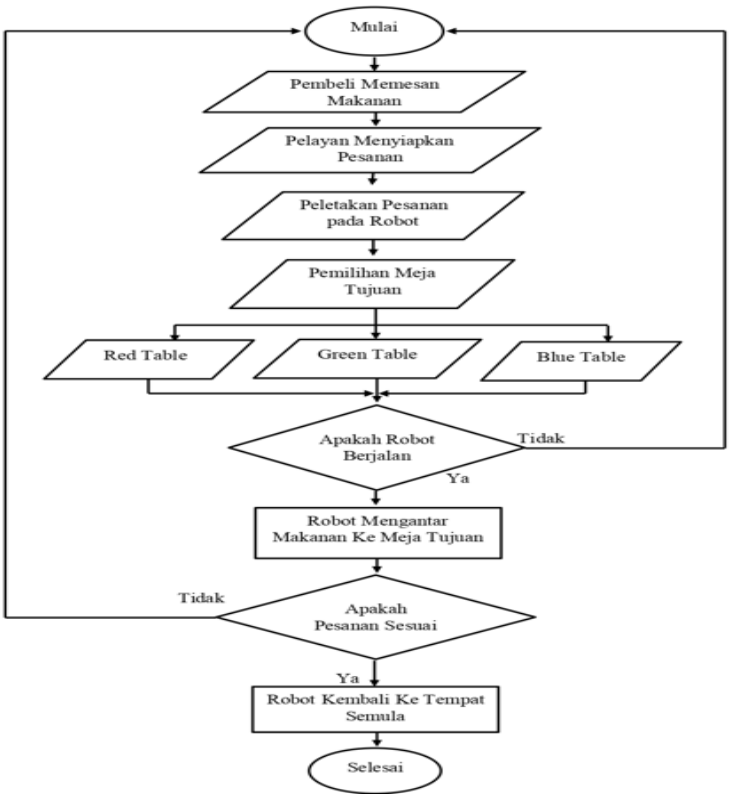
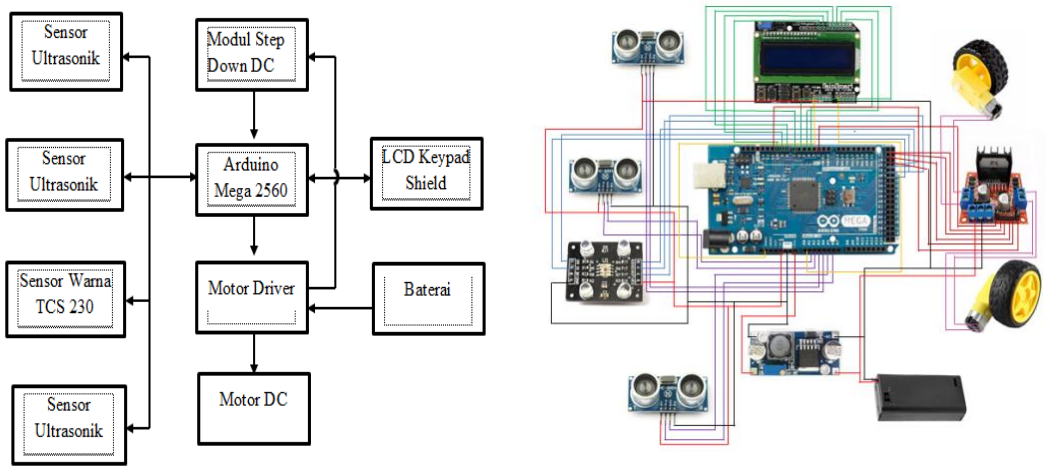


Figure 2. Flowchart

The explanation of each component in the flowchart in Figure 3.3 is as follows:

1. Two terminal symbols, representing the "Start" and "End" points of the information delivery system flowchart.
2. Seven input/output symbols, indicating the input/output processes: orders placed on the robot and commands given for it to move towards a table.
3. Two process symbols, representing the robot starting to move for order delivery and returning to its original position.
4. Two decision symbols, indicating a step for making a decision between "yes" or "no," such as whether the order is correct. If it is correct, the robot will stop, and if it is not, the robot will continue moving.

Robot design is a stage where all the necessary tools and materials are ready for use, followed by the creation of circuit design and the actual construction of the robot. The workflow of this food delivery robot system is crucial as it provides a clear understanding of how the robot should operate, serving as a reference for building the robot. The block diagram of this food delivery robot can be seen in Figure 3.a.



(a) (b)

Figure 3. a) Robot Block Diagram, b) Overall Robot Design Concept

The creation of this food delivery robot requires an initial design of the product to ensure a smooth construction process. The circuit design is particularly crucial when developing a complex device because it allows us to troubleshoot errors effectively. It is essential to have a concrete robot circuit design that facilitates our understanding of the necessary components for the project. The robot design concept can be seen in Figure 3.b.

4. Results and Discussions

The testing of the TCS 230 color sensor yielded several results, including the following:

a. Testing Different Colors

In this testing, the researcher aimed to determine whether the color sensor could detect colors other than Red, Green, and Blue (RGB) and observe the robot's condition. The results can be seen in Table 1 below.

Table 1. TCS 230 Color Sensor Testing Results Based on Different Colors

	Warna	Keadaan Robot
Sensor Warna TCS 230	Red	Stop
	Yellow	Move
	Green	Stop
	Orange	Move
	Blue	Stop
	White	Move
	Black	Move

b. Test at Ultrasonic Sensor

The testing process for the ultrasonic sensor differs from the color sensor testing because the ultrasonic sensor is used to measure distance, while the color sensor is focused on color recognition. The testing process involves several stages, as follows. The ultrasonic sensor can detect objects up to a maximum distance of 4 meters and the closest distance it can detect is 2 cm. The results of the ultrasonic sensor distance testing can be seen in Table 2.

Table 2. Ultrasonic Sensor Testing Results Based on Object Distance

	Distance (cm)	Robot Condition
Sensor Ultrasonik	5	Stop
	10	Stop
	15	Move
	20	Move
	25	Move
	30	Move
	35	Move
	40	Move

5. Results and Discussions

The conclusion of the design and development of a sensor-based robot for automated food delivery is as follows:

1. A prototype of a sensor-based robot for automatic food delivery has been successfully designed. In the design of this robot, the Arduino Mega 2560 is used as its microcontroller to control the sensors, which serve as the robot's sensory/detection devices. The working system of this robot is as follows: To start the robot, the power button located on the right side of the robot needs to be activated. Once activated, all the robot's circuits will power on, and the table menu will be displayed on the LCD Keypad Shield. The user can then select the desired table from the menu for food delivery and press the right button until the display shows "Red Table On" if a red table is chosen. The robot will move towards the designated table and will return automatically once the food has been taken.
2. The development of a sensor-based prototype robot for automatic food delivery has been realized because the researcher observed that in Indonesia, the process of food delivery in restaurants is generally still done manually. This situation often leads to long queues at eateries during lunchtime, especially when there are absent or sick employees. As a result, customers have to wait for a considerable amount of time to receive their food. In response to these issues, the researcher took the initiative to create a robot that can autonomously deliver food, thus alleviating the workload of the servers in serving customers.
3. The use of robots as servers is also more cost-effective compared to hiring additional employees, as it helps minimize expenses. Robots do not require wages, so the company only needs to provide regular maintenance to prevent them from getting damaged quickly. With the presence of this food delivery robot, it is expected to assist and facilitate business owners in the food delivery process, while also being beneficial for the community in their day-to-day tasks.

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